Nebraska Public Power District

SECTION G
TECHNICAL SPECIFICATION

A. NAME OF PROJECT

Gerald Gentleman Station (GGS) Units 1 & 2 Multi-Pollutant Control Project

B. LOCATION OF PROJECT

Gerald Gentleman Station
6089 South Highway 25
Sutherland, NE 69165-0068

C. DESCRIPTION OF PROJECT

The Gerald Gentleman Station Units 1 & 2 have a nominal rating of 705 MW and 745 MW, respectively. Unit 1 incorporates a Foster-Wheeler opposed wall-fired boiler firing Powder River Basin (PRB) fuels and Unit 2 incorporates a Babcock & Wilcox opposed wall-fired boiler firing PRB fuels. Unit 1 currently is equipped with low NOx burners (LNBs) and Overfire Air (OFA) ports. LNBs and OFA ports have recently been installed for Unit 2. Particulates are controlled using three reverse-gas baghouses for each unit. Unit 1 and 2 were both equipped with hot-side ESPs. Unit 1 ESP has been completely removed from the gas path system using a bypass duct. Unit 2 ESP is still part of the gas path, but with its internals removed. NPPD plans to demolish the ESPs prior to installation of the SCR system.

The purpose of the Project is to reduce plant emissions by adding pollution control equipment. A wet FGD system will be added to each unit to reduce SO_2 emissions and SCRs will be added to each unit for further NOx emission reduction.

The existing induced draft fans will remain in place. Booster induced draft fans, located downstream of the existing fans and upstream of the wet FGD system, are required to account for the additional pressure drop associated with the pollution control equipment and additional flue gas ductwork.

D. TECHNICAL REQUIREMENTS

The attached technical specification G-5334 (developed by the DISTRICT's Consulting Engineer, Sargent & Lundy LLC) encompasses the technical and performance requirements for this Contract.

CONTRACTOR's base scope of work includes the design, fabrication, inspection, and testing of the distributed control system (DCS) to be used to control, monitor and protect the multi-pollutant control systems and equipment added to Gerald Gentleman Station Units 1 and 2 as described above. Factory acceptance testing (FAT) and site acceptance

testing is included along with CONTRACTOR's field support for implementation of the DCS.

Nebraska Public Power District

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GERALD GENTLEMAN STATION UNITS 1&2

SECTION G
SPECIFICATION G-5334

DISTRIBUTED CONTROL SYSTEM (DCS)

ISSUE: CLIENT COMMENTS, REV. 0

DECEMBER 12, 2011

PROJECT NO. 12681-006

PREPARED BY
Sargent & Lundy, L.L.C.
55 East Monroe Street
Chicago, Illinois 60603

Sargent & Lundy LLC

SPECIFICATION

FOR

DISTRIBUTED CONTROL SYSTEM (DCS)

ISSUE SUMMARY AND APPROVAL

Rev.	Purpose of Issue	Date	Sections Affected
0	Client Comments	12-12-11	All

This is to confirm that this Specification has been prepared, reviewed and approved in accordance with Sargent & Lundy's Standard Operating Procedure SOP-0601, Project Procurement, which is part of our Quality Management System.

Rev.	Issue Purpose	Issue Date	Prepared By	Reviewed By	Approved By
0	Client Comments	12-12-11	Y.S. Lin	H. Singh	

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GERALD GENTLEMAN STATION UNITS 1&2
DISTRIBUTED CONTROL SYSTEM (DCS)

Specification G-5334
Issue: Client Comments, Rev. 0
December 12, 2011
Project No. 12681-006

CERTIFICATION OF SPECIFICATION
FOR
DISTRIBUTED CONTROL SYSTEM (DCS)

I certify that this Specification was prepared by me or under my supervision and that I am a registered professional Engineer under the laws of the State of Nebraska.

Sargent & Lundy, L.L.C. Nebraska Board of Professional Engineers and Architects authorization number is CA0395.

SEAL(S)

Revision:	Certified By:	Date:	Divisions / Sections Certified

DISTRIBUTED CONTROL SYSTEM (DCS)

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SECTION 011100

SUMMARY OF WORK & GENERAL REQUIREMENTS

PART 1 – GENERAL

101. SCOPE OF WORK

101.1 Design and Supply of Distributed Control Systems

a. The Distributed Control System (DCS) shall be a microprocessor based control system with distributed functions integrated by a data communication network designed to control, monitor, and protect the Units 1 and 2 Multi-Pollution Control (MPC) systems including wet FGD, ACI, ID booster fans, and associated balance of plant equipment.

a1. The DCS shall perform all control, monitoring, trending, reporting, alarming, and interface functions as described in these Specifications which set forth the minimum requirements for the design, materials, fabrication, inspection, and testing of the DCS. CONTRACTOR shall be responsible for integrating all DCS components and subsystems into a complete and operable DCS as well as the system configuration including logic, database, trending, logging, historical data collection and graphic programming, testing, documentation, delivery, and field support of installation and startup.

a2. CONTRACTOR shall also revise existing furnace draft control and burner management system, as required, for the addition of the MPC equipment and systems. The revised furnace draft control and burner management systems shall meet the NFPA 85 requirements.

b. CONTRACTOR shall prepare all factory test procedures and perform all Factory Testing as required by this Specification.

c. CONTRACTOR shall furnish all Spare Parts, Test Equipment and Special Tools required for the control system installation, startup, testing and operation through the period starting at initial system delivery through field acceptance testing and final acceptance of the system by Owner. The spare parts and test equipment shall be included in CONTRACTOR scope. CONTRACTOR shall furnish any special tools required to erect, adjust or dismantle each type of equipment furnished.

d. CONTRACTOR shall provide engineering and technical Field Services required for the system's design, technical assistance during installation, commissioning, operation and maintenance and as required by this Specification.

e. CONTRACTOR shall prepare all field test procedures and perform all Field Acceptance Testing as required by this Specification.

f. CONTRACTOR's design, manufacturing, configuring, testing and delivery schedule for the DCS shall be such that the complete system will be at the project site as hereinafter specified.

g. Attendance at meetings.

h. Access for shop inspection and tests including witness tests.

i. Technical Field Assistance as specified in Article 104 of this section.

101.2 Project Management Services

a. CONTRACTOR shall assign an experienced project manager for the duration of the project. CONTRACTOR's project manager shall have overall responsibility for the coordination of work throughout the project.

b. The CONTRACTOR's Project Manager shall be responsible for the cost, schedule, and performance of the CONTRACTOR's team including all sub-suppliers and subcontractors. The Project Manager shall provide project schedules and progress reports to the Owner and Engineer.

c. CONTRACTOR's Project Manager shall serve as the liaison for all communications between the CONTRACTOR and the DISTRICT's Engineer.

101.3 Software Upgrades and Updates

a. CONTRACTOR shall provide system software upgrades and updates until one (1) year after commercial operation of the plant. The software upgrades shall be made at no expense to the DISTRICT. Both the software and the installation services shall be at no charge to the DISTRICT.

102. WORK BY OTHERS

102.1 The Owner will furnish all labor, supervision, materials and equipment necessary for unloading, storing, installing, erecting, and commissioning of the specified equipment, including:

a. Utilities: Electrical power.

b. All external field cables, conduit and cable trays for power, instrumentation and control cables including all field cable terminations inside CONTRACTOR's equipment.

c. Main ground grid and connection to CONTRACTOR's cabinets

d. Concrete foundation

e. Fiber optic network cables. CONTRACTOR shall provide shielded copper network cables and media converters.

103. TERMINAL POINTS

103.1 The terminal points of CONTRACTOR's equipment scope of supply are listed below. Lack of reference to a specific terminal point does not relieve CONTRACTOR from providing the required interface for all such terminal points. CONTRACTOR shall provide interfacing design information at each terminal point.

a. Power and grounding field cable terminations

b. Instrumentation and control field cable terminations

c. Datalink and communication field cable terminations

104. TECHNICAL FIELD ASSISTANCE

104.1 CONTRACTOR shall provide the services of competent technical personnel to advise, assist and guide in the unloading, storage, erection, installation, testing and startup of the equipment, including tuning.

104.2 CONTRACTOR shall provide the services of competent technical personnel to instruct, advise and train Owner's personnel in the correct startup, safe operation, maintenance, testing and placing of the equipment in successful service.

104.3 CONTRACTOR's technical personnel shall cooperate with the Owner's erection contractors. Field personnel shall be capable, qualified and able to perform the duties required to the satisfaction of the Owner and shall be vested with authority to make decisions binding on CONTRACTOR.

104.4 CONTRACTOR shall provide necessary technical services as required to resolve preliminary operating problems as they develop until satisfactory operation is achieved. Field technical services for manufacturing errors shall be paid for by CONTRACTOR.

105. ERECTION COMPONENTS

CONTRACTOR shall furnish all special erection tools and instruments, if required, for erecting the equipment that are not normally furnished by equipment erectors. The CONTRACTOR shall identify which special erection tools can be furnished on a loan basis and terms thereof.

106. HAZARDOUS MATERIALS

106.1 As required under Federal Hazardous Communications Standards and certain state and local laws, the CONTRACTOR shall provide Material Safety Data Sheets covering all hazardous materials furnished under or otherwise associated with the work under this Contract. The CONTRACTOR shall provide the Owner with either copies of the applicable Material Safety Data Sheets or copies of a document certifying that no Material Safety Data Sheets are required under any federal, state, or local law, regulation, statute or ordinance in effect at the jobsite. CONTRACTOR shall identify those hazardous materials that remain on the jobsite at the end of the Project.

106.2 The supply or furnishing of materials and/or products containing asbestos or ceramic fiber is prohibited for any application.

END OF SECTION 011100

SECTION 011900

SITE DESIGN DATA

101. GENERAL

101.1 This section provides site design data and includes the following:

a. ASHRAE data.

b. Plant coordinate system.

102. ASHRAE DATA

102.1 Table 1-1 below lists the major site conditions, which are based on American Society of Heating, Refrigeration and Air Conditioning (ASHRAE) data.

TABLE 1-1
MAJOR SITE CONDITIONS

Parameter	Data
Nearest ASHRAE (2009 Fundamentals) weather data location	North Platte, Nebraska
World Meteorological Organization Number	725620
Latitude / Longitude	41.08°N / 101.14°W
Elevation	3,118 feet
Standard pressure	13.2 psia (26.8 in. Hg)
Heating dry bulb temperature, 99.6% occurrence	-7.7°F
Extreme wind speed, 1% occurrence	27.8 mph
50-year occurrence temperatures:	
High (Dry Bulb)	111.1°F
Low (Dry Bulb)	-35.2°F
High (Wet Bulb)	79.9°F
Cooling dry bulb temperature, 0.4% occurrence	96.3°F
Cooling wet bulb temperature, 0.4% occurrence	69.9°F

103. PLANT COORDINATE SYSTEM

103.1 GGS Plant Site Coordinates and Elevations Datum System shall be used for all work performed under this contract. CONTRACTOR shall incorporate the GGS Plant Site Coordinates and Elevations Datum System in all vendor design drawings, models, and construction documents. GGS Plant Site Coordinates and Elevations Datum System shall be used for all work performed under this contract. CONTRACTOR shall incorporate the GGS Plant Site Coordinates and Elevations Datum System in all vendor design drawings, models, and construction documents.

103.2 Baseline monuments indicating GGS Plant Coordinates and Elevations and their corresponding Nebraska State Plane Coordinates (NAD83) and NAVD88 Datum will be established by the DISTRICT and provided to the CONTRACTOR after the award as the basis of contraction. The CONTRACTOR shall verify the accuracy of the monuments, notify the DISTRICT of any deviation or discrepancy, and take full responsibility, hereafter, for the execution of contract.

103.3 CONTRACTOR shall install additional bench marks as necessary to facilitate construction. The additional construction bench marks shall be verified by an independent third party surveyor and reported to the DISTRICT for record prior to the commencement of construction.

END OF SECTION 011900

SECTION 013216
PROJECT SCHEDULE

PART 1 – GENERAL

101. PROJECT SCHEDULE REQUIREMENTS

101.1 General:

a. CONTRACTOR shall submit a detailed schedule showing all phases of the work to be done including procurement, fabrication, testing, delivery, etc. in accordance with the DISTRICT's General Contract Requirements.

b. CONTRACTOR's scheduling process shall be compatible with the Master Project Schedule. While the CONTRACTOR's schedule will be maintained independently, it must have the ability to be combined with all segments of the Master Project Schedule for overall Project reporting.

c. The DISTRICT and Consulting Engineer will review the CONTRACTOR's schedule, which will be used to coordinate the Work thereafter throughout the length of the project. The schedule will be incorporated into the Master Project Schedule that will include all activities of other manufacturers, sub-contractors and other parties working on the Project.

d. CONTRACTOR shall update the schedule on a frequency as directed by the DISTRICT to track actual progress against the established target schedule.

101.2 Schedule Requirements:

a. CONTRACTOR's design, manufacturing, delivery, and commissioning schedule shall be in accordance with the following schedule.

Activity	Date
DISTRICT's Release for Material Order and Fabrication	
Unit 2 and Common	TBD
Unit 1	TBD
DISTRICT Provides Preliminary Design Inputs to CONTRACTOR	
Unit 2 and Common	TBD
Unit 1	TBD
DISTRICT witnesses Factory Acceptance Test in CONTRACTOR's facility	
Unit 2 and Common	TBD
Unit 1	TBD
CONTRACTOR Deliveries Cabinets and Consoles	
Unit 2 and Common	TBD
Unit 1	TBD
Unit 2 Outage Begins	TBD
Unit 1 Outage Begins	TBD
Unit 2 Outage Ends	TBD
Unit 1 Outage Ends	TBD

b. It shall be the CONTRACTOR's responsibility to maintain the progress of its Work in accordance with the schedule.

c. The Master Project Schedule will be revised and updated as the Work progresses. It shall be the responsibility of the CONTRACTOR to provide progress reports as directed by the DISTRICT with information relating to actual fabrication, delivery and erection progress, as well as an update of CONTRACTOR's master document list.

d. Any changes made by the CONTRACTOR will be reviewed for the effect on DISTRICT's work. Any consequent change in DISTRICT's work shall be to CONTRACTOR's account.

END OF SECTION 013216

SECTION 017900

TRAINING

PART 1 – GENERAL

101. INTRODUCTION

101.1 If requested by DISTRICT, CONTRACTOR shall conduct on-site classroom training and provide on-site on-the-job training of sufficient scope and depth for scope of work components, equipment, sub-systems and systems to ensure the DISTRICT's operations and maintenance personnel are proficient in operations and maintenance. Such training will be provided for up to 15 persons per shift. The training will be provided during two separate shifts.

101.2 CONTRACTOR shall provide training services for the original equipment manufacturers (OEM's) components, equipment, sub-systems and systems supplied by the CONTRACTOR under the Contract scope of work.

101.3 CONTRACTOR shall identify the types and benefits of available simulators and the associated costs. CONTRACTOR shall provide recommendations regarding simulator use.

102. OBJECTIVES

102.1 The objective of the Owner's Operations and Maintenance (O&M) Training Program is to train the Owner's operations and maintenance personnel in the operation and maintenance of all equipment supplied by CONTRACTOR under their contract scope of work. Refer to Articles 105.3 and 105.4 for specific training completion objectives (TCO's).

102.2 Training at the project site shall include classroom instruction, site walkdowns and hands-on (on-the-job) training when available.

102.3 CONTRACTOR shall use quizzes and exams as required to evaluate trainee progress and understanding of the subject matter presented.

103. DISTRICT'S TRAINING GROUP WILL BE RESPONSIBLE TO:

103.1 Coordinate development of the DISTRICT's O&M Training Program by acting as a liaison between the Owner's management personnel, OEM's, vendors, contractors and engineering organizations.

103.2 Identify and furnish on-site facilities conducive to providing a distraction free training environment.

103.3 Schedule the Owner's O&M training to ensure personnel attend all sessions.

103.4 Review and provide comments to the CONTRACTOR on their submitted O&M Training Manual within thirty (30) days of receipt.

104. CONTRACTOR SHALL BE RESPONSIBLE TO:

104.1 Provide to the DISTRICT's TRAINING GROUP with a training plan (including a training session schedule) and an O&M Training Manual for their scope of work to meet the objectives herein, considered as the minimum requirements, no later than two (2) months prior to the scheduled training start date. Refer to Article 106 for specific O&M Training Manual requirements.

104.2 The DISTRICT will be allowed to video record all classroom training sessions.

104.3 Ensure that the number of knowledgeable on-site trainers, session periods and duration of training shall be sufficient to meet the objectives herein, considered as the minimum requirements.

104.4 Provide fluent English speaking knowledgeable instructors with suitable experience, technical and training skills for the scope of work training to instruct the Owner's O&M personnel.

104.5 Training on-site shall begin when the installation progress is at a level where the CONTRACTOR's major equipment has been installed or as determined by the DISTRICT's TRAINING GROUP. Training shall begin no later than two (2) months prior to the start of the Commissioning Phase of the Project.

105. TRAINING GENERAL REQUIREMENTS WILL INCLUDE:

105.1 Training classes conducted at the project site may be videotaped by others (subject to execution of a release form/agreement).

105.2 The training program will be carried out according to the requirements of each specialty. It will consist of:

a. Systematic explanation in a classroom of specific subjects

b. In-plant walkdowns as a part of the classroom training sequence

c. Hands-on training as the progress of construction allows

d. Supply of all the necessary training materials such as books, manuals, drawings, electronic files, etc.

105.3 CONTRACTOR shall provide the necessary on site training for their scope of work to enable the Owner's operations personnel to achieve the following training completion objectives (TCO's):

a. Familiarity with the components, equipment, sub-systems and systems

b. Understanding of the operational philosophy, concepts, and processes associated with the components, equipment, sub-systems and systems

c. Understanding of operational requirements for the components, equipment, sub-systems and systems for the following operational modes:

c1. Normal

c2. Abnormal (to the extent addressed by O&M manual materials)

c3. Emergency

c4. Start-up

c5. Transition (to the extent addressed by O&M manual materials)

c6. Alarm response (to the extent addressed by O&M manual materials)

105.4 CONTRACTOR shall provide the necessary on site training for their scope of work to enable the Owner's maintenance personnel to achieve the following training completion objectives (TCO's):

a. Familiarity with the components, equipment, sub-systems and systems

b. Understanding of the operational philosophy, concepts, and processes associated with the components, equipment, sub-systems and systems

c. Understanding of maintenance requirements, processes, work practices and required frequency / allowable frequency variation for the components, equipment, sub-systems and systems for the following maintenance types:

c1. Routine (preventive)

c2. Predictive

c3. Corrective

d. Understanding of the proper use and care of special tools associated with the components, equipment, sub-systems and systems

e. Familiarity with the recommended critical spare parts listing for the components, equipment, sub-systems and systems

105.5 CONTRACTOR shall allow the Owner's O&M trainees to retain all the technical documents supplied during the training.

105.6 CONTRACTOR shall conduct a training evaluation of each trainee, focusing on instructor observed classroom participation and results of quizzes, exams, etc. These results shall be confidentially provided to the Owner.

105.7 Each of the Owner's O&M trainees shall perform an evaluation of course content and instructor expertise with the subject matter for each lesson presented. These results shall be confidentially provided to the CONTRACTOR.

105.8 Once started and for the duration of the training program, the program shall not be interrupted unless mutually agreed upon by the CONTRACTOR and the DISTRICT's TRAINING GROUP and a re-start date is confirmed.

106. TRAINING MANUALS

106.1 CONTRACTOR shall provide an O&M Training Manual, which shall include as a minimum, system descriptions, operating procedures (normal, emergency, startup, shutdown, etc.), maintenance requirements, special tools use and care, critical spare parts requirements, drawings, schematics and lists (i.e., input/output, equipment, cable, instrument, etc.) for each of the scope of work components, equipment sub-systems and systems.

106.2 No later than two (2) months prior to the start of the Owner's O&M Training Program, the CONTRACTOR shall provide to the DISTRICT'S TRAINING GROUP:

a. Six (6) copies of the first draft of the O&M Training Manual.

b. One (1) electronic copy of the first draft of the O&M Training Manual shall be submitted to the DISTRICT's TRAINING GROUP at this time. The electronic copy shall be provided in PDF format.

c. CONTRACTOR shall revise the documents to incorporate reasonable DISTRICT'S TRAINING GROUP comments to the draft O&M Training Manual.

106.3 No later than one (1) month after acceptance of the draft O&M Training Manual, the CONTRACTOR shall provide to the DISTRICT's TRAINING GROUP:

a. 30 copies of the final O&M Training Manual.

b. One (1) electronic copy of the final O&M Training Manual shall also be submitted to the DISTRICT's TRAINING GROUP. The electronic copy shall be provided in PDF format.

END OF SECTION 017900

SECTION 409424

DISTRIBUTED CONTROL SYSTEM (DCS)

PART 1 – GENERAL

101 GENERAL TECHNICAL REQUIREMENTS

101.1 The Distributed Control System (DCS) shall be a microprocessor based control system with distributed functions integrated by a data communication network designed to control, monitor, and protect the Units 1 and 2 Multi-Pollutant Control (MPC) systems including wet flue gas desulfurization (FGD), selective catalytic reduction (SCR), ID booster fans, and associated balance of plant equipment.

101.2 The DCS shall be Honeywell Experion system of same software and hardware revision levels currently in use at the GGS.

101.3 The DCS shall perform all control, monitoring, trending, reporting, alarming, and interface functions as described in these Specifications which set forth the minimum requirements for the design, materials, fabrication, inspection, and testing of the DCS. CONTRACTOR shall be responsible for integrating all DCS components and subsystems into a complete and operable DCS as well as the system configuration including logic, database, trending, logging, historical data collection and graphic programming, testing, documentation, delivery, and field support of installation and startup.

101.4 CONTRACTOR shall also revise existing furnace draft control and burner management system, as required, for the addition of the MPC equipment and systems. The revised furnace draft control and burner management systems shall meet the NFPA 85 latest requirements.

102 SCOPE OF SUPPLY

102.1 CONTRACTOR shall supply, configure, test, assemble, and deliver a complete DCS for Units 1 and 2 MPC systems.

102.2 Major DCS components furnished by CONTRACTOR shall include, but are not limited to, the following. A detailed breakdown of this equipment for each subsystem is listed in Article 104.

a. Honeywell Experion C300 Controllers including system cabinets, processor modules, inputs/output (I/O) modules, power system supplies, field termination panels and internal wiring.

b. Remote I/O cabinets including remote I/O link extenders, I/O modules, power system supplies, field termination panels and wiring. These remote I/O cabinets shall include ID booster fan remote I/O cabinets to be used to control and monitor new ID booster fans.

c. Datalinks between DCS and PLC based control systems provided by other MPC equipment vendors.

d. Control consoles.

e. Fault Tolerant Ethernet (FTE) data highway communication components and cables to tie the new MPC equipment and systems into the existing plant systems. The data highway components shall include necessary switches and servers and shall be installed in network cabinets.

103 SYSTEM ARCHITECTURE

103.1 A block diagram (SK-409424-1) showing the MPC DCS system extensions can be found in Section I - Supplement Drawings.

103.2 The new MPC DCS shall be integrated into the existing Units 1&2 plant DCS network. Units 1 and 2 MPC shall be integrated with the Units 1 and 2 network respectively. Units 1&2 common system shall be integrated with a common network and shall be accessible from both Units 1 and 2 control consoles. Each of unit MPC systems comprises of FGD absorbers, SCR and other related supporting systems, e.g. auxiliary power system and service air/water, etc. Units 1 and 2 common system comprises of limestone preparation, dewatering, gypsum handling, SCR reagent and other related supporting systems. The DCS for the MPC systems shall be integrated into the existing station DCS in the station logic room through FTE data highway using fiber optic cables. For each of Units 1 and 2 MPC systems, one control console shall be provided and located in each of the Units 1 and 2 Absorber electrical equipment buildings (EEB). Another control console shall be provided and located in Common MPC EEB.

103.3 Each of Units 1 and 2 ID booster fan controls, through remote I/O, shall be tied into the existing boiler air flow/furnace draft controller, which is an Experion C300 Controller located in the station logic room.

103.4 To enhance reliability, the control loops shall be functionally distributed. The system shall include redundant processors with automatic fail over.

103.5 To enhance reliability, the system shall include redundant power supplies with automatic fail over.

103.6 The FTE data highway shall be a redundant, high-speed, communication network. All process data shall be available on the entire network.

103.7 Each system or communication node shall be designed such that the failure of any part of the system shall not affect the operation of any other part of the system, except for loss of data to the failed node.

103.8 Process network communications shall be transparent to all application-level users. All data shall be available for all displays, calculations, and control programs, regardless of network origin and without requiring additional calling procedures.

104 SUBSYSTEM

104.1 For operating and engineering purposes, the DCS is divided into functional subsystems. These subsystems include functional areas and equipment of the MPC systems that are completely controlled by new DCS controllers and operator consoles that require communication with the station DCS.

104.2 DCS hardware for all subsystems shall be similar and compatible. All subsystems shall be integrated to function as one continuous and seamless system. Subsystems required for this Contract shall include but not limited to, the following:

a. Unit 1 SCR System

a1. This subsystem shall control and monitor Unit 1 SCR, and other related BOP supporting systems.

a2. One (1) redundant Honeywell C300 Controller with I/O and field termination cabinets to be located in Unit 1 SCR EEB. CONTRACTOR may recommend additional controllers, if required, based on the estimated quantity of I/O.

a3. The approximate quantity of the hard I/O required for the Unit 1 SCR system is shown in Attachment 2.

b. Unit 1 Absorber System

b1. This subsystem shall control and monitor Unit 1 FGD absorbers, and other related BOP supporting systems.

b2. Two (2) redundant Honeywell C300 Controller with I/O and field termination cabinets to be located in Unit 1 Absorber EEB. CONTRACTOR may recommend additional controllers, if required, based on the estimated quantity of I/O.

b3. The approximate quantity of the hard I/O required for the Unit 1 Absorber system is shown in Attachment 2.

b4. Serial data links to the following third parties or systems:

b4.1 Unit 1 Oxidation Blower PLC.

b4.2 Unit 1 Auxiliary power system protective relays (the quantity of links to be determined)

c. Unit 1 ID Booster Fans

c1. This subsystem will control and monitor new Unit 1 ID Booster Fans.

c2. No new controller is required. Remote I/O shall be tied into the existing Unit 1 boiler air flow/furnace draft controller which is C300 Controller.

c3. One (1) Remote I/O cabinet will be located in Unit 1 Absorber EEB.

c4. The approximate quantity of the I/O required for the Unit 1 ID Booster Fans is shown in Attachment 2.

d. Unit 2 SCR System

d1. This subsystem shall control and monitor Unit 2 SCR, and other related BOP supporting systems.

d2. One (1) redundant Honeywell C300 Controller with I/O and field termination cabinets to be located in Unit 2 SCR EEB. CONTRACTOR may recommend additional controllers, if required, based on the estimated quantity of I/O.

d3. The approximate quantity of the hard I/O required for the Unit 2 SCR system is shown in Attachment 2.

e. Unit 2 Absorber System

e1. This subsystem shall control and monitor Unit 2 FGD absorbers and other related supporting systems.

e2. Two (2) redundant Honeywell C300 Controllers with I/O and field termination cabinets to be located in Unit 2 Absorber EEB. CONTRACTOR may recommend additional controllers, if required, based on the estimated quantity of I/O.

e3. The approximate quantity of the I/O required for the Unit 2 Absorber system is shown in Attachment 2.

e4. Serial data links to the following third parties or systems:

e4.1 Unit 2 Oxidation Blower PLC.

e4.2 Unit 2 Auxiliary power system protective relays (the quantity of links to be determined)

f. Unit 2 ID Booster Fan

f1. This subsystem will control and monitor new Unit 2 ID Booster Fans.

f2. No new controller is required. Remote I/O shall be tied into the existing Unit 2 boiler air flow/furnace draft controller which is C300 Controller.

f3. One (1) Remote I/O cabinet will be located in Unit 2 Absorber EEB.

f4. The approximate quantity of the I/O required for the Unit 2 ID Booster Fans is shown in Attachment 2.

g. Limestone Preparation System

g1. This subsystem will control and monitor Units 1 & 2 common limestone preparation systems.

g2. One (1) redundant Honeywell C300 Controller with I/O and field termination cabinets to be located in Common Limestone Preparation/Dewatering EEB. CONTRACTOR may recommend additional controllers, if required, based on the estimated quantity of I/O

g3. The approximate quantity of the I/O required for the Units 1 & 2 common limestone preparation systems is shown in Attachment 2.

h. Limestone Unloading System

h1. This subsystem will control and monitor Units 1 & 2 common limestone rail car unloading system.

h2. One (1) Remote I/O cabinet will be located in the Limestone Rail Car Unloading EEB. Remote I/O shall be tied into the Common Limestone Preparation C300 Controller.

h3. The approximate quantity of the I/O required for the limestone unloading system is shown in Attachment 2.

h4. Common auxiliary power system protective relays (the quantity of links to be determined).

i. Dewatering System

i1. This subsystem will control and monitor Units 1 & 2 common dewatering and gypsum handling systems.

i2. One (1) redundant Honeywell C300 Controller with I/O and field termination cabinets to be located in Common MPC EEB. CONTRACTOR may recommend additional controllers, if required, based on the estimated quantity of I/O.

i3. The approximate quantity of the I/O required for the Units 1 & 2 dewatering and gypsum handling is shown in Attachment 2.

j. SCR Reagent System

j1. This subsystem will control and monitor Units 1 & 2 common SCR reagent handling system.

j2. One (1) redundant Honeywell C300 Controller with I/O and field termination cabinets to be located in SCR Reagent Preparation EEB. CONTRACTOR may recommend additional controllers, if required, based on the estimated quantity of I/O.

j3. The approximate quantity of the I/O required for the limestone unloading system is shown in Attachment 2.

k. Control Consoles

k1. One (1) Honeywell EST Operator Station for Unit 1 MPC to be located in Unit 1 Absorber EEB.

k2. One (1) Honeywell EST Operator Station for Unit 2 MPC to be located in Unit 2 Absorber EEB.

k3. One (1) Honeywell EST Operator Station for Units 1 and 2 common limestone preparation shall be located in Common Limestone Preparation/Dewatering EEB.

l. Data Communication Network Components

l1. Experion server, Ethernet switches, power supplier and other miscellaneous components and necessary software license as required to be housed in a network cabinet and located in Unit 1 Absorber EEB.

l2. Experion server, Ethernet switches, power supplier and other miscellaneous components and necessary software license as required to be housed in a network cabinet and located in Unit 2 Absorber EEB.

l3. Experion server, Ethernet switches, power supplier and other miscellaneous components and necessary software license as required to be housed in a network cabinet and located in Common Limestone Preparation/Dewatering EEB.

PART 2 – PRODUCTS

201 DESIGN & FABRICATION

201.1 System Design

a. CONTRACTOR shall furnish all hardware, software and engineering required to control, monitor and protect the MPC systems with the DCS. The operator interface with CONTRACTOR supplied systems will be mainly through the plant's existing control room DCS operator stations. Additional consoles locally in the FGD electrical equipment buildings will be used for initial startup and future maintenance.

201.2 System Acceptability

a. All equipment shall be manufactured with quality components and good workmanship. Modern solid-state integrated circuits shall be utilized in electronic instruments and control components with digital technology emphasized, whenever applicable.

b. CONTRACTOR shall not propose nor provide equipment from any manufacturer for the duration of this Contract to be superseded or outdated by a later generation of equipment. CONTRACTOR shall not propose nor provide any control system (hardware or software) that is not in regular commercial use and service in installations of scope and magnitude similar to that for which the equipment is proposed or provided as a part of this Contract.

c. All functions defined in these Specifications shall be performed in an integrated cohesive manner. The architecture of the system must accommodate both functional and geographical distribution of the hardware and the software throughout the site, while allowing system-wide access to the distributed data.

201.3 Reliability

a. The proposed process control and information management system shall be designed to operate in a coal-fired power plant environment with a high degree of reliability. To this end, CONTRACTOR's system must meet these goals.

b. Minimize the Frequency of Failure: CONTRACTOR must be certified as being compliant with ISO 9001 and have an extensive quality assurance program designed to ensure a rigorously tested system. CONTRACTOR shall include details regarding the certification and quality program in the proposal.

c. Minimize the Consequences of a Failure: The distributed architecture of the proposed system should inherently minimize the consequence of failure. The system shall be designed so that the failure of one "node" will not affect another "node" in the system. On-line diagnostics shall be provided to troubleshoot a "node" or module failure.

d. Minimize the Duration of Failure: The duration of a failure shall be minimized by the capability to diagnose all problems quickly and to replace any failed part easily. The system shall provide graphical representation for card-level diagnostics.

e. Diagnostic alarms shall be configured by CONTRACTOR for all controllers, all power supply voltage levels, all modules, and all monitored cabinet temperatures. The diagnostic alarm text will identify the specific module causing the alarm; general alarms are unacceptable. All diagnostic alarms shall also be indicated on CONTRACTOR-supplied system status graphics.

f. Redundancies: Redundancies shall be included in the communication system, controllers, power supplies, and power sources. All redundant systems shall be configured to switch automatically, with no process excursions, upon a failure.

201.4 Expandability

a. The DCS shall be capable of being expanded beyond the base system. The addition of hardware and new functions shall not affect the functions operating in existing hardware nor shall it degrade the performance of the existing system. Expansion shall be possible in the following areas, if required:

a1. Addition of input/output points.

a2. Addition of controllers/processors.

a3. Addition of I/O modules

a4. Addition of operator consoles.

201.5 Maintainability

a. System maintenance procedures shall be simple, straightforward, and well documented.

201.6 System Availability

a. The DCS shall be designed to maintain a high degree of availability, supported by fault tolerant system architectures. The redundancy scheme for the system shall be such that no single component failure, except for non-redundant I/O devices (DCS hardware and field devices), shall cause a failure or interruption of control and monitoring functions. The DCS shall be designed such that failure of non-redundant I/O devices shall not cause damage to the equipment, and control logic shall start back up systems or revert to alternate control strategies wherever possible to minimize plant upset.

201.7 Support

a. CONTRACTOR shall confirm that the proposed control equipment will be supported by CONTRACTOR with the supply of spares and replacement parts being guaranteed for the expected useful life of the system. Support time period shall be at least 10 years.

201.8 Environmental Conditions

a. The DCS shall be warranted to operate in the environmental conditions that follow:

a1. Temperature: 50 degrees F to 85 degrees F.

a2. Humidity: 30 percent to 90 percent.

a3. In the event of failure of the air conditioning equipment, the DCS shall withstand temperatures ranging from 32 degrees F to 104 degrees F and humidity from 10% to 90% for extended periods of time.

b. EMI/RFI Interference:

b1. The DCS shall be supplied with provisions for protecting against system errors and hardware damage resulting from electrical transients on power or signal wiring. These transients include those generated by switching large electrical loads, by power line faults, and due to lighting strikes which induce surges on power or signal cables. The IEEE Standard 472-1974 shall apply to all system power inputs and signal inputs from field device.

b2. The DCS shall be immune from these EMI/RFI interferences in accordance with SAMA Standard PMC 33.1-1978.

202 DCS EQUIPMENT

202.1 System Cabinets

a. CONTRACTOR shall design and supply a rigid, self-supporting, free-standing cabinet for incorporation within a suite of bolted cabinets.

b. Cabinets shall be completely fabricated, assembled, wired, and tested before leaving CONTRACTOR's factory.

c. Cabinet shall be capable of being bolted together and panel sides shall be removable.

d. Front and rear access system cabinets shall be fully enclosed. All system cabinets shall be front and rear access cabinets.

e. All system cabinets shall have a locking handle.

f. The cabinets shall have suitable provisions for top and bottom wiring access.

g. DCS cabinet doors and panels shall be fitted with dust-tight seals and shall conform to NEMA 12.

h. All cabinets shall be provided with ventilation filters to prevent entry of dust. Filters are to be designed to be removed and serviced without the use of tools.

i. System cabinets shall be delivered fully assembled with all internal equipment mounted in place and all internal interconnecting wiring securely terminated.

j. Doors and Hinges:

j1. Access to the equipment mounted within the panel shall be from lockable, vertically hinged doors.

j2. Hinges shall be designed to allow the easy removal of the entire door.

j3. All door locks shall be provided with the same lock and key configuration.

j4. Keys shall be removable with the doors either locked or unlocked. It shall be possible to open unlocked doors without needing a key.

j5. CONTRACTOR shall furnish a key for each enclosure door lock.

j6. A metallic pocket shall be provided on the inside of the door to contain drawings and data.

k. Cabinet Ventilation:

k1. Cabinets shall be provided with adequate ventilation to ensure the internal ambient temperature does not exceed the safe, continuous-operating temperature of the components located therein. Maximum internal ambient temperature rise is to include allowance for the full spare capacity to be fully implemented.

k2. Where necessary, the cabinet design may incorporate fans and blowers. All fans and blowers shall utilize an integral filter assembly on the air intake, located so that filter removal for cleaning is easily accomplished. Any DCS cooling fans or blowers shall operate with a noise level less than 45 dB at 1 meter.

202.2 Wiring and Cables

a. AC Power Wiring:

a1. Any internal wiring within the system cabinets operating at 120 VAC shall be stranded copper wire, not smaller than No. 14 AWG, with 600-volt, flame-retardant thermosetting compound insulation meeting UL VW-1 requirements.

a2. The system cabinets shall utilize electrical terminal strips installed in sufficient quantity to service the required power supplies, cooling fans, etc.

b. Grounding: The system cabinets shall have ground bars for safety and master reference ground. Grounding cables between the safety and plant master reference ground hall be No. 4 AWG or larger.

c. Signal Level Wiring:

c1. Electronic signal level wiring within the system cabinets shall be in accordance with manufacturer's standard wire sizes, insulation, and method of termination.

c2. All cabinet wiring shall be secured in wiring ducts with 30 percent spare capacity by volume.

d. Prefabricated Cables:

d1. Prefabricated cables shall be pre-wired, plug-in type using high-quality connectors and requiring a minimal amount of installation time. All cable insulation shall be flame-retardant thermosetting compound meeting UL VW-1 requirements.

d2. CONTRACTOR shall furnish prefabricated cables of the required length for connecting all workstation monitors, keyboards, and pointing devices to their respective workstations.

d3. All pre-fabricated cables shall be labeled with termination information with a Brady-type label maker or equivalent.

202.3 System Power Supplies:

a. Two sources of 120 VAC power will be supplied for each system cabinet assembly requiring power supplies.

a1. Primary Power Source: 120 VAC, 60 Hertz.

a2. Back-up Power Source: 120 VAC, 60 Hertz.

b. The power supplies shall include conditioning necessary to accommodate ±10% voltage variation of the Purchaser's electrical supply to the system.

c. Two completely redundant power sources shall be included by CONTRACTOR for each of the control processor and I/O:

c1. The output of the power supplies for each control subsystem shall be connected together through diode auctioning, so that if one power source fails, the other will pick up the load without interruption of the power to the control subsystem.

c2. It shall be possible to change out power supplies with the system online.

c3. The power supplies shall provide 24 VDC contact wetting voltage for all 24 VDC system powered digital inputs.

c4. Alarms shall be provided to indicate failure of any single power supply.

c5. Power supply failure detection shall be performed by a device independent of the control processor.

c6. The power supplies shall have appropriate overcurrent protection.

c7. Each power supply shall be sized to power the complete control system, plus at least 20 percent spare capacity above and beyond the 20 percent spare capacity specified elsewhere.

c8. Each power supply shall be independently protected by a circuit breaker which shall be easily accessible for resetting.

202.4 Processor Modules

a. Control processors shall be Honeywell C300 Controllers of the same type and revision as those currently in use at the GGS.

b. Module addresses shall be switch or software selectable (i.e., any card in any slot).

c. All components and assemblies shall be subjected to an established "burn-in" procedure during manufacturing to detect premature failures prior to shipment.

d. All processor modules used in all the functional subsystems of the DCS for control and monitoring shall be supplied in redundant configuration.

e. Redundant processor pairs shall be identical with respect to hardware and software characteristics. One member of each pair shall be designated the primary unit and the other member shall be a hot stand-by

backup. If the primary unit fails, the hot standby unit shall immediately assume all of the functions of the primary unit.

f. Each processor of a redundant pair shall be dual bound to the data highway. Each member shall be capable of communicating on either the primary or secondary data highway network.

g. Both automatic and manual transfer of control between processors shall be bumpless and continuous with no interruption of the process control function.

h. On-line software configuration changes shall be possible.

i. The primary processor shall either, automatically or upon operator command, update and change the software in the hot stand-by unit any time a program change occurs.

j. All processor modules shall be capable of being removed and/or inserted into the system while power is applied.

k. Upon board or system failure, all controller outputs, analog or discrete, shall be configurable to fail to a known state including:

k1. Fail to minimum output or fail off.

k2. Fail to maximum output or fail on.

k3. Remain at their last output value.

l. Each module shall include on-board diagnostics, with self-checking features to allow detection of processor malfunctions. On-board LED indictors shall be provided on each module for indication of operating status.

m. Main programs shall be held in non-volatile memory.

n. All random access memories (RAM) shall be non-volatile or utilize battery backup to retain memory for a minimum of 350 hours on loss of system power.

o. Processors shall be capable of re-initialization following a computer failure or long-term proven failure

p. Processors shall be sized such that memory utilization and duty cycle shall not exceed 50% of capacity.

q. Processors shall be capable of data communication with other microprocessor-based equipment furnished by CONTRACTOR. Communication with medium voltage switchgear shall be via Ethernet or other serial link communication protocol.

202.5 Inputs and Outputs (I/O) Modules:

a. General:

a1. CONTRACTOR shall supply all input and output modules and termination hardware to satisfy hardware requirements for the operation of the MPC equipment and systems.

a2. CONTRACTOR shall provide 20% spare I/O by type per each cabinet.

a3. If not provided as part of the previously described control processor capabilities, the I/O card functionality shall provide the ability to configure a signal fail state to minimum, maximum, or the last output value.

a4. The I/O modules (cards) shall be capable of accepting the input/output signals described below and used in conjunction with the associated controller modules described herein.

a5. All required peripheral or auxiliary equipment for signal conditioning, impedance matching, balancing, ground detection, and other similar functions shall be furnished and installed by CONTRACTOR.

b. Digital Inputs:

b1. General:

b1.1 Digital input cards shall be able to be located in any processor I/O cabinet.

b1.2 Provisions shall be made for digital inputs to be deleted from and restored to scan status.

b2. Power Sources:

b2.1 Digital input circuitry for digital inputs shall be high impedance.

b2.2 Digital input modules shall be capable of interfacing with input voltages of 24 VDC when system is powered or 120 VAC when field powered.

b3. Isolation, Fuses, and Buffering:

b3.1 Each input on a digital input module shall be isolated; common interrogation voltage connections shall not be provided.

b3.2 Any requirements for relay buffering of discrete inputs due to limitations of the DCS equipment shall be stated in the bid as noted on the Bid Forms and any such required equipment shall be provided and installed by CONTRACTOR.

b4. Contact inputs shall be provided with contact bounce filtering. The filter shall delay contact inputs to protect against input device bounce and electrical noise on input lines.

b5. Single-ended digital inputs shall be fused individually.

c. Pulse Inputs:

c1. The DCS shall be able to receive inputs from periodic (or pulse) input devices. A periodic input shall be defined as: A zero-based pulse, rectangular wave, or sinusoidal wave form with a rate of 0 to 50,000 pulses per second (50 KHz frequency).

c2. Information regarding pulse count, pulse duration, and pulse frequency shall be available for use in custom-application software.

d. Digital Outputs:

d1. Digital Output Switching Requirements:

d1.1 Digital output contacts shall be isolated and capable of switching 125 VDC and 120 VAC loads. Unless noted otherwise, each digital output shall have an electromechanical relay which isolates the output from the digital circuitry. Digital outputs shall be rated for proper application.

d1.2 Each digital output shall be able to switch a minimum of 5 amps at 120 VAC or 0.5 amps at 125 VDC.

d1.3 Unless specified otherwise, all contacts shall close on the specified condition and shall normally be in the de-energized state. Normal condition shall be energized to close, with the open condition being the alarm or trip condition. Relay outputs shall be normally open, energize to close under normal operation, and open to alarm or trip. DCS system internal design shall prevent contact output transient operation on DCS failure or power down.

d1.4 Any requirements for relay buffering or interposing relays of contact outputs or restrictions for simultaneous loading of outputs on a single output module due to limitations of the DCS equipment shall be stated by CONTRACTOR in the bid.

d1.5 Solid-state relays shall be used for repetitive or pulsing type outputs and for hardwired control signals between DCS subsystems.

d2. Protection and Fuses:

d2.1 Fail-safe features required on discrete outputs include a configuration option to fail open, fail closed, or hold last state on loss of communication with the control processor.

d2.2 Internal circuit protection for output modules shall be provided such that a fault on one output does not cause other outputs to fail.

d2.3 All required transient protection shall be internal to the output module.

d3. Power Supply: The system shall provide the capability to supply power for contact outputs from I/O power supplies within CONTRACTOR's systems or from an external power source.

e. Analog Inputs:

e1. General

e1.1 1) Analog input modules shall be furnished with individual, analog-to-digital converters (A/D) on a per-module basis. The A/D shall accept all ranges of inputs expected from thermocouples, RTDs, analog transmitters, slide wires, or any commonly used dc current or voltage signal from a process transducer.

e1.2 2) Analog input system shall include all required precision resistors.

e1.3 3) A software filter shall be provided to filter out process noise on certain analog inputs. The time for conversion shall be compatible with the specified input scan rate.

e1.4 The system shall provide the capability for software selection of scan rate on an individual analog point basis. All analog inputs shall be scanned at a minimum rate of four times per second.

e1.5 The removal of analog input cards for service or maintenance shall not affect the continuity of current inputs, provided the terminal block has been jumpered before removing the card.

e1.6 The system shall provide the following capabilities for analog inputs:

e1.6.1 Provision for analog inputs to be deleted from and restored to scan status.

e1.6.2 Provision for analog inputs to be deleted from and restored to alarm status.

e1.6.3 Provision for different conversion types which shall include linear, thermocouple, RTD, flow compensation, polynomial approximation for special input, and all other types required for this application. Each of the conversion types shall have the capability to handle different ranges for the variable. High-level programs shall be used for special conversion types.

e1.6.4 Input conversion to engineering units shall be software based such that each point on any I/O card can have its own range.

e1.6.5 Switches or jumpers shall be used to make the selection of internal or external power for each point on the input modules. CONTRACTOR shall install any necessary jumpers as required by the Engineer.

e1.7 The A/D conversion performed by the analog input shall have 12 bit or greater resolution.

e2. 4-20 mADC Inputs

e2.1 The system shall provide 4-20 mADC two wire input, 250 OHM maximum input impedance. DCS shall provide 24 VDC power sources with individual current limiting protection.

e2.2 The system shall provide 4-20 mADC two wire input, 250 OHM maximum input impedance, field powered with individual current limiting protection.

e2.3 All 4-20 mADC inputs shall have out of range validity check and alarms.

e3. Thermocouples:

e3.1 All thermocouple inputs shall be checked for open circuit with each thermocouple scan. The delay between the check and the determination of an open-circuit condition shall not be more than 1 second.

e3.2 Standard conversions shall be provided for all thermocouple types in both degrees F and degrees C.

e3.3 Thermocouple input cards shall be designed so that different thermocouple types can be mixed on each thermocouple module. This capability shall include, as a minimum, ungrounded or grounded thermocouples of types E, J, T, and K.

e3.4 The system shall include selectable linearization for thermocouples and cold-junction compensation.

e3.5 A separate thermocouple reference junction with automatic temperature compensation shall be provided for each thermocouple module. The thermocouple reference junction temperature compensation value shall be available for display to the operator and shall have alarm limits. The system shall have only one dissimilar metal junction per thermocouple input.

e4. Resistance Temperature Detectors (RTD):

e4.1 The system shall be compatible with two-wire, three-wire, and four-wire RTD types. Selectable linearization types shall include 100-ohm platinum, 10-ohm copper, and 120-Ω nickel RTD types.

e4.2 Bridge circuits and power supplies required for resistance temperature detectors and slide wires shall be provided in the I/O cabinets.

e5. Terminal Blocks: Terminal blocks for analog inputs shall be sized to receive a 22- to 16-AWG wire.

f. Analog Outputs:

f1. The system shall provide the following capabilities for analog outputs:

f1.1 Provision for analog outputs to be overridden and restored to normal mode.

f1.2 Analog outputs shall be fused on a per card basis and shall produce 4-20 mADC current loops capable of driving 750-ohm loads at 24-volts DC.

f2. All analog outputs shall be monitored by continuous system diagnostics.

f3. All analog outputs shall be short-circuit and open-circuit protected and may be grounded or ungrounded. Galvanic isolation shall be provided for all analog outputs.

f4. An open loop in any analog output shall result in a control action to be defined during detailed system engineering.

f5. Fail-safe features required on analog outputs include a configuration option to fail minimum, fail maximum, or fail last on loss of communication with the control processor.

f6. Internal circuit protection for output modules shall be provided such that a fault on one output does not cause other outputs to fail.

f7. Terminal Blocks: Terminal blocks for analog outputs shall be sized to receive a 22- to 16-AWG wire.

g. HART I/O

g1. The DCS analog I/O modules shall have the capability to receive the HART digital information directly from the field device without the need for an external signal converter or splitter. The field device information shall be available for maintenance and troubleshooting.

g2. The DCS shall support HART device and module assignment, configuration, and diagnostics.

h. Sequence of Event Inputs:

h1. The status change of these inputs shall be discriminated to a minimum of one millisecond apart and printed in their proper sequence. Each event shall be displayed and printed as an individual event.

h2. The time shall be printed in hours, minutes, seconds, milliseconds for each sequential event.

h3. An event is considered complete when all SOE inputs have been sensed or a preset time interval, determined by the Purchaser, has elapsed since the last detected contact change. The system shall record and store up to two separate SOE logs without data loss. At the completion of the event, a SOE log shall be automatically printed. The program shall list the events chronologically and print the log in its entirety.

i. Data Communication Links

i1. The DCS shall be capable of serial or Ethernet communication links to third parties or systems. The data links shall be used for equipment diagnostic and alarming purpose but not for control and protection functions which shall be through hard wires.

j. I/O Partitioning

j1. The DCS shall have adequate input/output capability and be configured to provide maximum loop integrity. Inputs or outputs on each card shall be arranged so that the pulling of any card will require only one critical loop to be in manual, and/or one motor control service from complimentary pairs of equipment (e.g. Absorber Recycle Pumps A or B) to be out of service.

j2. The following ground rules apply to the distribution of I/O to achieve the specified requirements:

j2.1 1) Redundant transmitters shall be assigned to separate input cards.

j2.2 2) Inputs from redundant field devices shall be assigned to separate input cards

j2.3 3) Outputs servicing complementary pairs of equipment shall be assigned to separate output cards.

j2.4 4) Each I/O module shall contain a minimum of 20% spare points.

202.6 Field Termination Panels

a. CONTRACTOR shall provide marshalling termination panels for field wiring.

b. Panel Requirements:

b1. All analog and digital field devices will be wired to the I/O modules through marshalling termination panels.

b2. The terminal blocks for all field connections shall be located in the marshaling termination panels in vertical rows convenient for CONTRACTOR's cabling with fan-out space required for termination.

b3. Termination panels shall be designed for top or bottom entry of field cables, and space shall be provided for standoffs for cable ties of sufficient length, width and depth to hold the required 12 AWG and smaller field cables.

b4. Terminal blocks shall not be mounted on the panel doors or external of the panels.

b5. Cable routing space shall provide for separation of signal and digital cables. Each terminal block shall have a terminal block designation tag.

b6. Termination panels shall be equipped with copper equipment grounding bus bars and isolated copper signal grounding bus bars. The grounding bus bars shall be properly labeled as to their use.

b7. Terminal blocks shall include twenty percent spare for future expansion of the I/O.

202.7 Control Console Stations

a. General:

a1. The control consoles shall be provided for multifunctional purposes. Each console shall allow the operator and engineer to monitor, control and operate the process and equipment of the DCS.

b. Communication and Redundancy:

b1. Each operator console station shall be connected to the DCS network as a node.

b2. No single point of failure, including communications links, shall render more than one station inoperative.

c. Furniture:

c1. The operator console shall be Honeywell Icon-series or Owner approved equal. The final arrangement of the console shall be approved by Owner.

c2. Four individual tilting and swiveling flat panel monitors installed in two tiers shall be provided.

d. Monitors:

d1. Each console shall be provided with four monitors.

d2. The monitors furnished with the consoles shall be a minimum 21-inch, industrial-quality, high-resolution (1,280 by 1,024 or greater) flat-screen LCD, color type, suitable for continuous-duty operation.

d3. LCD monitors shall be equipped with tilt and swivel stands for installation on a desktop surface.

d4. LCD monitors shall have a 4:3 aspect ratio and a minimum contrast ratio of 300:1. Minimum viewing angle shall be 160 degrees.

e. Software:

e1. CONTRACTOR shall install and test the operating system and all other supplied software required in these Specifications prior to shipment.

e2. Each operator workstation shall be pre-loaded with supporting software drivers and all software licenses as required to provide a fully functional operator workstation.

f. Instructions:

f1. Instructions shall be specific to operating system, software, version, etc., of each workstation.

f2. Instructions shall be written in a manner such that detailed knowledge of networking operating systems or specific applications are not necessary to re-install the software.

g. Operator Station Functions: Each operator workstation shall be capable of performing, as a minimum, the functions described below:

g1. Monitor and control of the process via interactive graphic displays and operator keyboard/mouse.

g2. Graphics elements shall be identified and executed by a point-and-click device, such as a mouse.

g3. Display of graphics, including overview displays, group displays, and custom graphics.

g4. Monitor the status or value of any point in the system or plant database.

g5. Transfer controllers from automatic to manual operation to control outputs and adjust set points.

g6. Real-time trends of any variable in the system.

g7. Assembly and output of logs, including trip, trend and event, and alarm logs as a minimum.

g8. Retrieval of archived system data.

g9. Provide password security access to all system functions. If required, both user-level and group-level security settings shall be available. The operator station shall provide user-profile settings that retain individual preferences for trend displays, operator logs, and any operator-configurable characteristics.

h. Operator Station Displays:

h1. CONTRACTOR shall design and configure DCS graphic screens for the new MPC systems and processes using color codes, equipment graphic details, etc. consistent with the plant's standards. This shall include overview, main, control window pop-up, and alarm graphic screens. CONTRACTOR shall use the existing plant DCS graphic convention.

h2. Real-time data on displays, including alarms, shall be updated at 1-second intervals or less for a screen with 250 points.

h3. Operator station response shall be such that any graphic requested for display on a screen shall be completed, including all real-time data, within 1 second after the request is initiated.

h4. It shall be possible for displays to be user configurable and operator interactive. Display information arrangement shall be independent of field I/O and distributed system controller locations.

i. Data Presentation:

i1. The DCS shall be capable of trending operator assignable database points and providing short-term storage of the trended data. Basic trend groups for each analog control loop shall be pre-configured, along with performance summary trends. Custom trends shall be user configurable.

i2. The DCS shall permit the operator to define groups of points for display in either tabular or graphic form, and shall permit multiple groups to be saved in memory.

i3. The DCS shall include utilities for preparation and printing of periodic logs. Basic shift, daily, and monthly logs shall be pre-configured. Custom logs shall be user configurable.

i4. The DCS shall include provisions to permit the operator to select a subset of the plant database for display as a group.

j. Alarms:

j1. The DCS shall provide alarm functions, including alarm management capabilities to optimize the operator response to off-normal conditions.

j2. The operator workstations shall provide alarm indicators on every display such that the operator will always be informed of equipment and process alarms.

j3. User-configurable global alarm acknowledge and global alarm silence functionality.

j4. All alarms shall be capable of multiple severity levels indicated by logging, time stamp, and audible tones. At least four levels shall be possible.

j5. The DCS shall alarm the occurrence of abnormal events in an easy to read form of monitor based alarm display summaries, printed alarm logs, and audible tones. Sequence-of-events monitoring shall be provided for those conditions that can directly trip the unit or a major piece of equipment, (e.g., ID booster fans). All Sequence-of-Events (SOE) alarms shall have 1 millisecond resolution. A listing of Sequence-of-Events points shall be made available to the DISTRICT for review and approval. SCR and FGD related SOE points will be integrated in the main plant SOE report

j6. All analog values shall be monitored and alarmed for being outside reasonable limits. Alarm conditions or levels shall be established to allow for operator action before a subsequent trip. All alarm and trip functions shall be displayed in the consoles. The alarm circuits shall be designed to show no alarms when the monitored equipment or system is operating normally. Alarm inhibit logic shall be implemented to prevent nuisance alarms (e.g., low pump discharge pressure will be inhibited by pump not running).

j7. Analog values generating alarms shall feature incremental alarm values with appropriate deadbands to advise the operator of deteriorating or improving process conditions.

j8. Alarm group indication and a means of immediate access to alarm screens shall also be provided. From the alarm display, it shall be possible to immediately (two keystrokes) call the applicable control displays for variables that are in the alarm state.

j9. Means shall be provided to sound an audible alarm, and to silence, acknowledge, and reset alarms.

203 COMMUNICATIONS

203.1 Network and Data Highway:

a. CONTRACTOR shall supply all necessary network components and cables and other hardware required for the system to communicate between all processors and workstations. Long distanced fiber cables between MPC electrical equipment rooms and the station logic room will be furnished by DISTRICT.

b. The data highway and all related hardware will be fully redundant based on FTE technology. There shall be no single point of failure, either physical or logical, which could interfere with communications between any two nodes. Redundancy shall extend to the processor bus interface level, including redundant interface modules, termination units, and cables that connect the communication network to each process control unit.

c. Each of redundant data highway cables will be routed in a separate cable race or conduit. The maximum cable length is 300 feet for a copper cable and 2,000 meters for a fiber optic cable.

d. Transfer of system communication from any primary to secondary network device shall be alarmed on the operator stations.

204 CONTROL LOGIC CONFIGURATION

204.1 General

a. After award of the Contract, a combination of control narratives, system descriptions, and control logic diagrams will be provided to CONTRACTOR to use as a guide in developing the system configuration. These documents will generally depict function and operation to plant personnel. They are not intended, nor will they be supplied in sufficient detail for directly programming the DCS. CONTRACTOR is to utilize these diagrams as a basis for the development of the complete DCS programming. CONTRACTOR shall make any additional recommendations that will improve the proposed operational procedures or method of control.

b. The DCS shall provide stable operation and shall minimize system trips. The control logic shall provide an automatic means to stabilize unit operation in an attempt to prevent occurrences of unit trips. Upon detection of such conditions, the following actions listed below shall be initiated, until the threat of a trip is eliminated.

b1. Provide adequate alarms to detect abnormal conditions.

b2. Rundown the unit load demand at a predetermined rate until the condition improves.

b3. On loss of an auxiliary, runback the boiler/turbine to a predetermined unit load demand, at a controlled runback rate. CONTRACTOR shall advise the need to implement a unit load runback for unavailability or trip of a critical piece of equipment.

204.2 Plant Protection

a. The following considerations and criteria are the general requirements for protection of the plant.

a1. The DCS shall include logic that automatically protects the equipment from exposure to damage. Equipment protection designs shall be in proportion to equipment cost or its effect on the cost of operations, but protection designs shall never compromise personnel safety.

a2. The protective logic shall isolate the faulted equipment while maintaining unaffected equipment on line, whenever possible, and minimize the amount of time required to re-establish proper operation and to bring systems back on-line.

a3. If the detected fault creates a risk of damage to other systems, the protective logic shall initiate actions to protect the plant from damage.

a4. In general, on failure of a controller/processor function, protective trip outputs must fail to the safe (usually tripping) position. A total loss of control power must result in a trip of equipment that has trip protection. Other equipment, (such as lube oil pumps), which are required to prevent damage during the shutdown of other systems, shall be designed to remain in the run state in the event of a total control system fault.

a5. Consideration shall be given to the utilization of redundant transducers and/or qualification of critical inputs. When the loss of one input could require manual operation of a significant portion of the controls, or disables protective logic, redundancy shall be employed.

b. The following applies to critical control loops and auxiliaries that if operated out-of-limits will cause loss of power generation or potentially cause catastrophic damage to a major plant auxiliary:

b1. The control system shall be fault tolerant such that no single component failure shall cause a failure or interruption of control and monitoring functions.

b2. The control logic for triple redundant field instrumentation shall perform median select logic for analog loops and 2-out-of-3 logic for digital loops. Triple instrumentation will be used on critical control loops and to those devices, which directly affect protection tripping. Deviation alarms shall be provided for redundant analog and digital instrumentation.

204.3 Plant Control

a. The DCS shall provide a consistent operator interface to control functions throughout the system, with identical philosophies for status and mode indication, operator actions, etc.

b. Interlocks shall be incorporated to ensure the safe, sequential start-up and shutdown of the system equipment. Sufficient interlocks, timing, circuits and monitoring shall be provided to ensure proper operations, maximum safety and reliability under all modes of operation, and to minimize operator actions or equipment failure from creating unsafe conditions or damaging equipment.

c. Wherever possible, the DCS shall utilize thresholds of analog transmitter input values to create digital points for discrete logic control and interlocks instead of the use of field mounted process switches. All analog values shall be monitored and alarmed for being outside reasonable limits.

d. The closed-loop controls shall be incorporated into each modular controller/processor for automatic control of the major subsystems. The control loops shall regulate flows, pressures, temperatures and levels through variable measurement, comparison with a setpoint or demand, and control action by a control valve/actuator. Control setpoints may be fixed or variable based on a parameter, and shall be determined by the "unit" level control microprocessor, not from a higher level processor such as an operator console server. Completely automatic operation of the loops shall be standard; however, the operator may elect to take over remote manual operation of an actuator from the operator console.

e. All analog values shall be monitored and alarmed for being outside reasonable limits. Alarm conditions or levels shall be established to allow for operator action before a subsequent trip. All alarm and trip functions shall be displayed in the operator workstations. The alarm circuits shall be designed to show no alarms when the monitored equipment or system is operating normally. Alarm inhibit logic shall be implemented to prevent nuisance alarms (e.g., low pump discharge pressure will be inhibited by pump not running).

PART 3 – EXECUTION

301 TESTING AND ACCEPTANCE

301.1 Testing:

a. Factory Checkout: Prior to shipment, CONTRACTOR shall perform, as a minimum, the following assembled system checks. The DISTRICT will witness checkout and shall be given two-weeks advance notice.

a1. Wiring and grounding.

a2. Power supply voltage levels and diagnostic alarms.

a3. Power supply failover and alarming.

a4. Power to each system module.

a5. Verification of each communication path.

a6. Communication path failover and alarming.

a7. Check operation of all I/O channels.

a8. Processor failover and alarming.

a9. Control function verification for start-up, normal and emergency shutdown operations including, but not limited to:

a9.1 Keyboard algorithm

a9.2 Analog control functions such as manual reject, tracking function, manual/auto bumpless transfers, proper auto control action.

a9.3 Digital control functions such as start/stop permissive, automatic interlock.

a9.4 Trip functions

a10. Alarm summary, trending, logging, historical data collection and storage demonstrations.

a11. The system shall only be shipped on DISTRICT's release of the DCS for shipment.

301.2 Acceptance

a. Site Acceptance Test

DISTRICT shall conduct acceptance tests after installation to determine if the equipment and materials furnished as part of the work performed as specified and as guaranteed. Final acceptance and start of guarantee period will be based on acceptable results of such tests.

302 FIELD SERVICES/ENGINEERING

302.1 CONTRACTOR shall furnish the services of competent technical personnel to provide technical advice, assistance, and guidance in the erection of the DCS equipment. CONTRACTOR shall also provide the services of competent startup personnel at the job site to tune the system and train DISTRICT's personnel as necessary until successful completion of performance tests.

302.2 CONTRACTOR's field personnel shall be capable, qualified, and able to perform the duties required to the satisfaction of DISTRICT and shall be vested with authority to make decisions binding on CONTRACTOR.

END OF SECTION 409424

ATTACHMENT 1

PROPOSAL DATA

Name of Bidder: _____

Insert All Information within Brackets

1. **MANUFACTURING LOCATION**

1.1 Describe the physical locations where design, procurement, manufacturing, assembly and testing will take place..... [_____]

2. **POINTS OF SHIPMENT FOR EQUIPMENT TO BE SHIPPED TO THE GERALD GENTLEMAN STATION**..... [_____]

3. **PRELIMINARY PROPOSAL DATA/DRAWINGS** Provided with the proposal (yes or no?)

3.1 Block diagram showing interconnection of all cabinets and major pieces of equipment. ..... [_____]

3.2 Drawings or sketches to detail plans, elevations, and space requirements for cabinets, and consoles. ..... [_____]

3.3 System, marshalling, and termination cabinet arrangement drawings/sketches to indicate processors, I/O cards, power supply, I/O termination areas, etc. ..... [_____]

3.4 Bill of Material with recommended spare parts identified ..... [_____]

3.5 Descriptions of any recommended special tools, devices, and services required for installation, operation, and maintenance of equipment detailing their need and usage..... [_____]

3.6 List and description of Contractor operating systems, application programs and other software available. ..... [_____]

3.7 Describe recommendations that define the required modifications including integration of the new systems into the existing DCS network..... [_____]

3.8 Preliminary Engineering, manufacturing and system delivery schedules. ..... [_____]

4. **NET WEIGHTS** (not shipping weight) (lb.), as follows:

4.1 Weight of each controller cabinet..... [_____]

4.2 Weight of each I/O cabinet..... [_____]

4.3 Weight of each Remote I/O cabinet..... [_____]

4.4 Weight of each Network cabinet ..... [_____]

4.5 Weight of each operator console ..... [_____]

5. **PHYSICAL DIMENSIONS**

Bidder shall include additional sheets as necessary to completely define the system equipment.

5.1	Honeywell C-300 Controller Cabinets:	Unit 1	Unit 2	Common
a.	Number of cabinets.....	[_____]	[_____]	[_____]
b.	Length (each).....	[_____]	[_____]	[_____]
c.	Height (maximum)	[_____]	[_____]	[_____]
d.	Depth	[_____]	[_____]	[_____]
5.2	I/O Cabinets:	Unit 1	Unit 2	Common
a.	Number of cabinets.....	[_____]	[_____]	[_____]
b.	Length (each).....	[_____]	[_____]	[_____]
c.	Height	[_____]	[_____]	[_____]
d.	Depth	[_____]	[_____]	[_____]
5.3	Remote I/O Cabinets:	Unit 1	Unit 2	Common
a.	Number of cabinets.....	[_____]	[_____]	[_____]
b.	Length (each)	[_____]	[_____]	[_____]
c.	Height	[_____]	[_____]	[_____]
d.	Depth	[_____]	[_____]	[_____]
5.4	Network Cabinets:	Unit 1	Unit 2	Common
a.	Number of cabinets.....	[_____]	[_____]	[_____]
b.	Length (each)	[_____]	[_____]	[_____]
c.	Height	[_____]	[_____]	[_____]
d.	Depth	[_____]	[_____]	[_____]
5.5	Operator Consoles:	Unit 1	Unit 2	Common
a.	Number of consoles	[_____]	[_____]	[_____]
b.	Length (each).....	[_____]	[_____]	[_____]
c.	Height	[_____]	[_____]	[_____]
d.	Depth	[_____]	[_____]	[_____]

e.	Number of LCD monitors (each)	[_____]	[_____]	[_____]
6.	**POWER REQUIREMENTS**	CTLR Cabinet	I/O Cabinet	Remote I/O Cabinet
6.1	Voltage, phases and frequency	[_____]	[_____]	[_____]
6.2	Voltage regulation allowed (%).....	[_____]	[_____]	[_____]
6.3	Frequency regulation allowed (%).....	[_____]	[_____]	[_____]
6.4	KVA (each).....	[_____]	[_____]	[_____]
6.5	Maximum harmonic content allowable (%)	[_____]	[_____]	[_____]
6.6	Maximum inrush current and time.....	[_____]	[_____]	[_____]

7. **DIGITAL INPUT/OUTPUT SYSTEM**

7.1	Manufacturer/model of output relay	[_____]
7.2	Contact rating at 125 Vdc/120 Vac:	
a.	Resistive	[_____]
b.	Inductive	[_____]
7.3	Type of contact output if relays are not used.....	[_____]
7.4	Voltage used for input interrogation.....	[_____]
7.5	Is twisting of conductor pairs or shielding required for contact closure output leads?.....	[_____]

8. **DRAWING SUBMITTAL SCHEDULE**

8.1	Detailed Project Schedule (weeks after contract date).....	[_____]
8.2	System Layout Drawings (weeks after contract date)	[_____]
8.3	Cabinet Layout drawings (weeks after contract date).....	[_____]
8.4	I/O partition database (weeks after receiving DISTRICT's preliminary I/O lists.).....	[_____]
8.5	SAMA and logic diagrams (weeks after receiving DISTRICT's design inputs).....	[_____]
8.6	Factory Acceptable Test Procedure (weeks before the tests)....	[_____]

ATTACHMENT 2

ESTIMATED I/O QUANTITIES

1. UNIT 1 SCR SYSTEM

TYPE	QUANTITY
Analog Input (4-20mA)	TBD
Analog Output (4-20mA)	TBD
Thermocouple Input	TBD
100 Ohm RTD Input	TBD
Digital Input (24VDC) –DCS Powered	TBD
Digital Input (120VAC) – Field Powered	TBD
Digital Input (125VDC) – Field Powered	TBD
Digital Output (Dry Contact)	TBD
Pulse Input	TBD
SOE Input	TBD

2. UNIT 1 ABSORBER SYSTEM

TYPE	QUANTITY
Analog Input (4-20mA)	TBD
Analog Output (4-20mA)	TBD
Thermocouple Input	TBD
100 Ohm RTD Input	TBD
Digital Input (24VDC) –DCS Powered	TBD
Digital Input (120VAC) – Field Powered	TBD
Digital Input (125VDC) – Field Powered	TBD
Digital Output (Dry Contact)	TBD
Pulse Input	TBD
SOE Input	TBD

3. UNIT 1 ID BOOSTER FANS

TYPE	QUANTITY
Analog Input (4-20mA)	TBD
Analog Output (4-20mA)	TBD
Thermocouple Input	TBD
100 Ohm RTD Input	TBD
Digital Input (24VDC) –DCS Powered	TBD
Digital Input (120VAC) – Field Powered	TBD
Digital Input (125VDC) – Field Powered	TBD
Digital Output (Dry Contact)	TBD
Pulse Input	TBD
SOE Input	TBD

4. UNIT 2 SCR SYSTEM

TYPE	QUANTITY
Analog Input (4-20mA)	TBD
Analog Output (4-20mA)	TBD
Thermocouple Input	TBD
100 Ohm RTD Input	TBD
Digital Input (24VDC) –DCS Powered	TBD
Digital Input (120VAC) – Field Powered	TBD
Digital Input (125VDC) – Field Powered	TBD
Digital Output (Dry Contact)	TBD
Pulse Input	TBD
SOE Input	TBD

5. UNIT 2 ABSORBER SYSTEM

TYPE	QUANTITY
Analog Input (4-20mA)	TBD
Analog Output (4-20mA)	TBD
Thermocouple Input	TBD
100 Ohm RTD Input	TBD
Digital Input (24VDC) –DCS Powered	TBD
Digital Input (120VAC) – Field Powered	TBD
Digital Input (125VDC) – Field Powered	TBD
Digital Output (Dry Contact)	TBD
Pulse Input	TBD
SOE Input	TBD

6. UNIT 2 ID BOOSTER FANS

TYPE	QUANTITY
Analog Input (4-20mA)	TBD
Analog Output (4-20mA)	TBD
Thermocouple Input	TBD
100 Ohm RTD Input	TBD
Digital Input (24VDC) –DCS Powered	TBD
Digital Input (120VAC) – Field Powered	TBD
Digital Input (125VDC) – Field Powered	TBD
Digital Output (Dry Contact)	TBD
Pulse Input	TBD
SOE Input	TBD

7. LIMESTONE PREPARATION SYSTEM

TYPE	QUANTITY
Analog Input (4-20mA)	TBD
Analog Output (4-20mA)	TBD
Thermocouple Input	TBD
100 Ohm RTD Input	TBD
Digital Input (24VDC) –DCS Powered	TBD
Digital Input (120VAC) – Field Powered	TBD
Digital Input (125VDC) – Field Powered	TBD
Digital Output (Dry Contact)	TBD
Pulse Input	TBD
SOE Input	TBD

8. LIMESTONE UNLOADING SYSTEM

TYPE	QUANTITY
Analog Input (4-20mA)	TBD
Analog Output (4-20mA)	TBD
Thermocouple Input	TBD
100 Ohm RTD Input	TBD
Digital Input (24VDC) –DCS Powered	TBD
Digital Input (120VAC) – Field Powered	TBD
Digital Input (125VDC) – Field Powered	TBD
Digital Output (Dry Contact)	TBD
Pulse Input	TBD

9. DEWATERING SYSTEM

TYPE	QUANTITY
Analog Input (4-20mA)	TBD
Analog Output (4-20mA)	TBD
Thermocouple Input	TBD
100 Ohm RTD Input	TBD
Digital Input (24VDC) –DCS Powered	TBD
Digital Input (120VAC) – Field Powered	TBD
Digital Input (125VDC) – Field Powered	TBD
Digital Output (Dry Contact)	TBD
Pulse Input	TBD
SOE Input	TBD

10. SCR REAGENT SYSTEM

TYPE	QUANTITY
Analog Input (4-20mA)	TBD
Analog Output (4-20mA)	TBD
Thermocouple Input	TBD
100 Ohm RTD Input	TBD
Digital Input (24VDC) –DCS Powered	TBD
Digital Input (120VAC) – Field Powered	TBD
Digital Input (125VDC) – Field Powered	TBD
Digital Output (Dry Contact)	TBD
Pulse Input	TBD